U. S. DEPARTMENT OF AGRICULTURE.

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Experiment Station Work,

XXIII.

Compiled from the Publications of the Agricultural Experiment Stations.

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CURING CHEESE IN COLD STORAGE.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.
A. C. TRUE, Director.

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EXPERIMENT STATION WORK.

Edited by W. H. Beal and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. True, Director, Office of Experiment Stations.

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ILLUSTRATIONS.

EXPERIMENT STATION WORK.[a]

LOSSES IN MANURE.[b]

Prof. W. Frear of the Pennsylvania Station has recently reported observations on the losses during two months of fertilizing constituents from steer manure kept under the feet of the animals in a box stall with cement floor and from that removed daily from stalls with hard clay floors and stored in a compact heap under cover, enough fine-cut litter being used in each case to apparently absorb all liquid manure. The results confirm those obtained by the Ohio Station, to which attention has already been called,[c] in showing that manure loses much less of its fertilizing constituents in deep stalls than in heaps. In the Pennsylvania Station experiments the deep-stall manure was trampled to a very dark, compact mass, and although only about two-fifths of the dry matter of the food and litter was recovered in the manure there was very little loss of the valuable fertilizing constituents—nitrogen, phosphoric acid, and potash. With the manure kept in heaps one-third of the dry matter of food and litter was recovered in the manure and one-third of the nitrogen, one-fifth of the potash and one-seventh of the phosphoric acid was lost, the total money value of the losses being equivalent to $2.50 for each steer stabled for six months.

The untrampled manure, therefore, suffered more extensive losses of organic matter and nitrogen than the trampled manure, owing chiefly to the more complete exclusion of air in the latter case. It also experienced losses of phosphoric acid, and especially of potash, which can be explained, under the conditions of the experiment, only by the leakage of liquid manure into the earth floor of the stalls. Part of the loss of nitrogen doubtless occurred in the same way, but relatively less than of the potash, which was more soluble. Evidently manure can be kept almost perfectly, so far as

[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from Pennsylvania Sta. Bul. 63.

[c] U. S. Dept. Agr., Farmers' Bul. 162 (Experiment Station Work, XXI), p. 5.

the fertilizer constituents are concerned, by use of the first or "deep-stall" system. * * * Experiments show, however, that ammonia is lost very rapidly by such manure, if it be allowed to lie after the removal of the stock, without such covering as will retain the moisture and exclude the air.

MACARONI WHEATS.[a]

Macaroni wheats have from time to time been introduced into the United States during the past thirty-five years, but lack of demand for them has until recently prevented any extensive culture of these wheats, although "Wild Goose" or "Goose," an inferior grade of macaroni wheat, has been grown to some extent in Canada and the Northwest United States for many years. A few years ago, however, this Department undertook systematic work with a view to introducing improved varieties of macaroni wheats and building up a home market and foreign demand for macaroni flour. The experiment stations and private individuals have cooperated very effectively with the Department in testing the wheats under varying conditions and in studying the qualities and uses of the product. This work has been so successful that there is good reason for the belief that the United States will in time not only produce all the macaroni it consumes, but supply a considerable proportion of the macaroni and macaroni flour used abroad.

The characteristics, adaptabilities, varieties, cultivation, market, etc., of macaroni wheats have been fully discussed in a bulletin of this Department, and experiments with different varieties of these wheats have been reported by several experiment stations, including those of South Dakota and Nebraska. From these sources the following summary of the principal facts relating to macaroni wheat and its culture in the United States has been prepared:

The macaroni wheats are so called because they are largely used in the manufacture of macaroni and other edible pastes. These products are much used for food in Europe, and are constantly becoming more widely used in this country. The wheats belong to the group *Triticum durum*, while the common wheats belong to *Triticum vulgare*. The macaroni wheats are tall, with broad, smooth leaves. The heads are heavily bearded, being much more so than any of the ordinary wheats, and the plant when headed has much the appearance of barley. The heads are large and vary in color from light yellow to almost black, depending upon the variety. The kernels are large, very hard, having less starch than common wheat. They vary from light yellow to reddish yellow in color.

The habits of growth of durum wheats adapt them to regions of light rainfall. They have great ability to withstand drought and heat, but require a rich soil, although they are notably tolerant of alkali.

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[a] Compiled from Nebraska Sta. Bul. 78; South Dakota Sta. Bul. 77; U. S. Dept. Agr., Bureau of Plant Industry Bul. 3.

Hence they are especially adapted to growth in the semiarid regions of the United States, and render possible the building up of a profitable industry in regions in which ordinary wheats do not succeed and which, without irrigation, are of little or no value except for grazing purposes. The macaroni wheats have been found to give the best results on the Great Plains near the hundredth meridian, but the work of the Department and of the stations shows that they may be successfully grown over quite a wide area. In milder climates the macaroni wheats are sown in the fall, but they will not stand severe winters, and they are successfully grown only as spring wheats north of the thirty-eighth parallel in the United States. Where they can be grown as winter wheats, that is, south of the thirty-fifth parallel, they furnish good winter and spring pasturage.

The experiments of the South Dakota Station show that macaroni wheats of good quality can be raised in all parts of that State, and that they yield from 25 to 100 per cent more than the best quality Blue Stem and Fife wheats under ordinary conditions and give fair yields in seasons too dry for ordinary kinds. While macaroni wheats are grown in a number of countries, the best varieties are of Russian origin. The best Russian varieties, and those recommended by Carleton as especially adapted to the middle and northern portions of the Great Plains, are Kubanka, Yellow Gharnovka, Black Don, Beloturka, and Velvet Don. Among the varieties recommended for the region south of the thirty-fifth parallel are Nicaragua, Medeah, and Pellissier. The following varieties were found to yield well by the South Dakota Station: Pellissier, Berdiansk, Kubanka, Arnautka, Gharnovka, Yellow Gharnovka, Taganrog, Argentine, Medeah, Velvet Don, and Black Don. The Nebraska Station has made comparative tests of several Russian and Algerian varieties, the former proving on the average somewhat superior to the latter.

The macaroni wheats are cultivated in about the same way as ordinary wheats, except that somewhat heavier seeding ($1\frac{1}{2}$ bushels per acre) is advisable on account of the fact that the macaroni wheats do not stool extensively. Great care should be taken to keep the seed pure if the quality of the product is to be maintained. The inferior quality of the "Wild Goose" or "Goose" wheat, above referred to, is probably due to the fact that it has been grown for many years without attempt to keep the seed pure.

The macaroni wheats are much harder than the ordinary hard wheats. In composition they differ from ordinary wheats in a smaller percentage of starch and a larger percentage of protein or nitrogenous matter (gluten, etc.). In samples examined by Professor Shepard, of the South Dakota Station, the protein varied from 13.9 to 18.8 per

cent. Ordinary wheats have on the average 11.8 per cent of protein. As a consequence of the higher protein content of the macaroni wheats the flour and by-products yielded by them are also richer in this very valuable food constituent than those obtained from ordinary wheat. South Dakota macaroni-wheat flour contained 16.9 per cent of protein, the bran 16.3 per cent, and the shorts 17.4 per cent. Ordinary wheat flour contains 11.4 per cent of protein, bran 15.4 per cent, and shorts 14.9 per cent. The flour—or, as it is termed, semolina—from macaroni wheats makes a richer macaroni than that of ordinary hard wheats, which has been used to a considerable extent by macaroni manufacturers. Macaroni of the highest quality was made from the macaroni wheats grown in South Dakota and analysis showed it to contain 16.5 per cent of protein. The inferior quality of the macaroni made from flour of ordinary wheats is generally recognized in the trade. This has resulted in an increasing demand on the part of macaroni manufacturers, which has only partly been met by the millers, for semolina from macaroni wheats. It is safe to assume that as this demand increases the millers will be induced to make the slight alteration in their milling machinery necessary to grind the macaroni wheat and will supply the flour required for our growing domestic manufacture as well as for an increasing export trade.

If, however, all of the macaroni wheat grown can not be disposed of profitably for the manufacture of macaroni, it may be used to advantage as a feeding stuff or for bread making as is done in Russia and other European countries. The South Dakota Station has shown that macaroni flour can be made into a sweet bread of good flavor, which is a little richer in protein than that made from ordinary flour of average composition. It has also been demonstrated to be well suited to the preparation of biscuits, muffins, griddle cakes, and similar products of good quality. For bread it is often considered desirable to mix 20 per cent or more of red-wheat flour with the macaroni-wheat flour.

STERILIZING GREENHOUSE SOILS.[a]

As the census figures show, the growth of the horticultural industry in the United States has been remarkable, probably 100 per cent in the last ten years. No small proportion of this increase has been due to the extension of culture under glass, of which there was, according to the Eleventh Census, somewhat over 96,000,000 square feet in the United States June 1, 1900. Professor Galloway states that "proba-

[a] Compiled from Massachusetts Sta. Rpts. 1901, p. 74; 1902, p. 38.

bly nowhere in the world has the growing of plants in greenhouses attained such importance as in the United States."

While, as a rule, conditions are under better control in greenhouses than out of doors, very different methods of culture are required, and plants grown in greenhouses are subject to many troubles which are difficult to control and which often menace the success of greenhouse culture unless radical preventive measures are adopted.

Prof. G. E. Stone, of the Massachusetts Station, has shown that sterilization of the soil by heating is a very effective means of preventing or controlling the worst of these enemies of greenhouse plants, and this method is now used with success by many large market gardeners. The method as worked out by Professor Stone, in experiments extending over a number of years, is especially effective in case of lettuce drop, timber rot of cucumbers, Rhizoctonia of lettuce, cucumbers, etc., damping off, and nematode root disease, all of which are common diseases in greenhouses. As would be expected, the treatment is effective only with diseases transmitted through the soil and is without influence on diseases disseminated through the air.

Soil sterilization has been practiced on a small scale, mainly for experimental purposes, for many years, but its application on a large commercial scale has been quite recent. Attempts have been made to apply the method out of doors, for example, in tobacco plant beds, but it is mainly applicable and is used with most success in greenhouses.

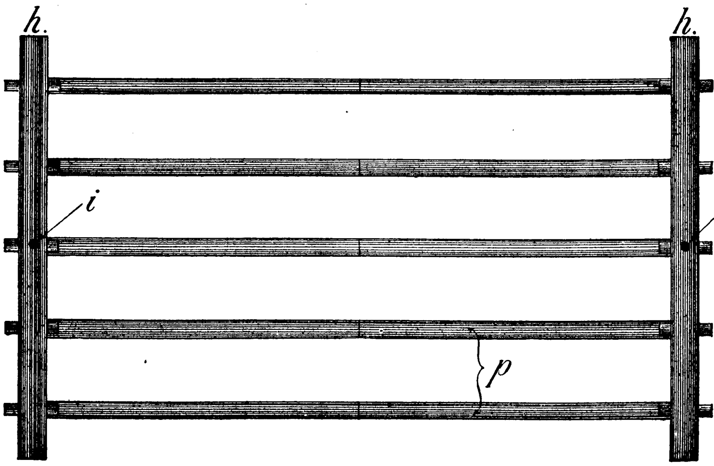
Various methods of sterilization and forms of sterilizing apparatus, using either steam or hot water, have been proposed and tried. If hot water is used the treatment must be repeated each year; if the steam treatment is thoroughly applied it is said to be effective for several years.

The heating by steam is now done largely by the aid of perforated pipe, and in some cases use is made of 2-inch porous tile, although this method is not so practicable. If finely perforated tile could be obtained in the market at a reasonable cost their use would be much more valuable for this purpose than at present. The various contrivances are constructed of perforated pipe, varying from 1 inch to 3 inches in diameter, usually placed from 7 to 12 inches apart, and made up into frames from 10 to 20 feet or more in length and of any desired width. The size and number of the perforations vary much in different appliances. When they are rather large (¼ inch in diameter) they are frequently covered with burlap. In some appliances the perforations are ¼ inch in diameter and are only 1½ inches apart each way; in others the perforations may be only ⅛ inch in diameter and from 3 to 6 inches apart, with two or three rows of such holes extending around the circumference of the pipe.

Professor Stone's later experiments indicate that 2-inch pipes with three-sixteenths to one-fourth inch perforations are most effective.

Some of the appliances are not made up into permanent frames, but are in sections easily put together or taken apart (fig. 1) and are so constructed that they can be readily extended to any length or width desired. These frames are provided with headers (*h*)

placed transversely, which are pipes of larger diameter containing perforations, and nipples (n) are inserted at intervals which readily fit into the extension pipes (p). In some instances the headers are placed at each end, thus forming with the extension pipes a frame composed of a series of rectangles (fig. 1, A). In this form a complete circulation of the steam can take place. In others the headers are in the middle and



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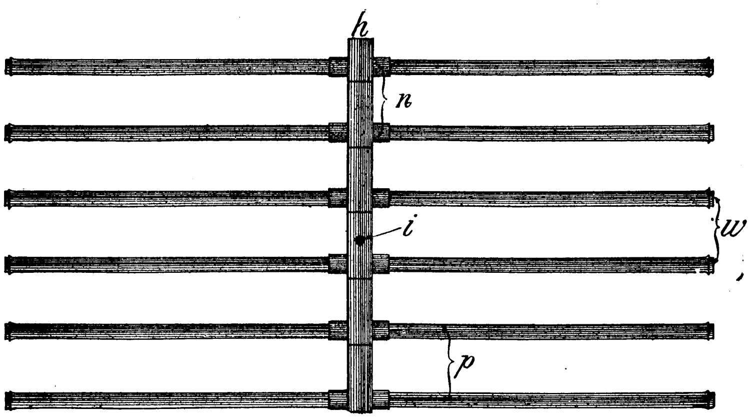

B

FIG. 1.—Types of sterilizing apparatus. Inlets for steam at *i*.

the extension pipes lead off into opposite directions (fig. 1, B). In the latter case the ends of the extension pipes are plugged with wood (w) and a complete circulation of steam does not occur. The material most frequently used is iron pipe. * * *

The method generally adopted by lettuce growers in heating their soils is to place the apparatus on the surface of the bed. If the bed is 20 feet wide, then it will be most convenient to have the heating appliance about 10 feet wide and 20 to 30 feet

long. This is placed midway between the edges of the bed, and the soil to the depth of 1 foot is dug out on either side of the appliance and thrown on top of it. This covers the heating apparatus to a depth of 1 foot. The steam is now turned on and the soil heated. After sufficient steaming has taken place, the pipes can be pulled out and set up ready for the next treatment. (See fig. 2.) The soil previously treated should be covered up with some old canvas, if available, or, in fact, with anything that will retain the heat, and allowed to stand some hours, after which the top portion is shoveled back to where it was taken from. Not only is the 1 foot of top soil heated by this method, but the soil under which the apparatus rests is equally well done, provided too much haste is not made in removing the treated soil.

A uniform temperature of 180° F., maintained for 1½ to 2 hours, is considered effective, but in order to be on the safe side it is better to exceed this temperature somewhat.

As regards the cost of sterilizing, not including that of tile or apparatus, Professor Stone says:

In a house 225 feet long by 20 feet wide, one-third of which was treated at a time by steam passing through 2-inch tile placed 8 inches below the surface and 1 foot

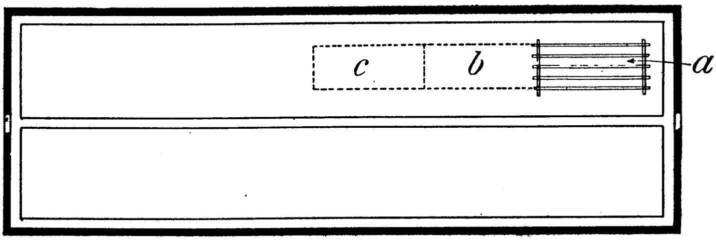

FIG. 2.—Plan of house, showing method of sterilization.

apart, and forming a continuous circuit, the cost was at the rate of $16 for 1,000 cubic feet, where the pressure of steam used varied from 30 to 80 pounds. * * *

Another house, 40 feet wide by 300 feet long, was treated by a lettuce grower with an average pressure of 30 pounds of steam passed through 1-inch iron pipes furnished with a series of perforations 6 inches apart and three-sixteenths inch in diameter. These pipes were made up into a frame, 7 inches distant from one another. The estimated cost of sterilizing 1,000 cubic feet of soil, based upon the treatment of the whole house, was $8.33.

In large-scale operations the cost has been found to be less than $5 per 1,000 cubic feet, and often as low as $2.

When soil can be sterilized at $2 per 1,000 cubic feet, or even at $5, there is no longer any question concerning the practical application of this method to rid greenhouses of some of their worst enemies which interfere with the production of healthy and profitable crops. Even when the cumbersome tile method is employed, the cost of sterilization is less than one-half the cost of removing the old soil from a house and supplying it with new.

A loss of 15 to 20 per cent due to lettuce drop alone has been prevented by this method, and plants show, as a rule, better germination and growth (as high as 33 per cent), and improved quality on sterilized soil.

TOMATOES UNDER GLASS.[a]

The tomato is one of our most popular vegetables. It is widely grown as a market crop, and is used for canning to a greater extent than any other vegetable. The constant demand for fresh fruit the year round, especially in large cities, has made the tomato a profitable forcing-house crop, and many experiments by the stations to determine the best varieties, methods of culture, etc., have been reported. Interesting experiments along this line have recently been reported from the New Hampshire, Iowa, and Illinois stations.

The varieties of tomatoes commonly recommended and used for forcing are the tall or standard sorts, but Prof. F. W. Rane's experiments at the New Hampshire Station emphasize the value of the dwarf varieties for this purpose. In these experiments the varieties were grown in beds on the ground. The soil used was made by mixing together equal parts of a rich dark loam, sand, and manure. The subsoil was first loosened to a depth of about 6 inches and then about 6 inches of the prepared soil put on top of it. The seed was planted in trays September 27. When large enough to handle, the plants were transplanted and kept in pots until December 27, when the house was ready for forcing. Shortly after the plants came into bearing they were watered once or twice a week with liquid manure, the amount being increased as the plants grew. The temperature of the house was kept between 60° and 70° F. at night and between 70° and 80° F. during the day.

Three varieties, Dwarf Champion, Dwarf Golden Champion, and La Crosse Seedling were used in the experiment. Good, stocky plants of these were set in a bed 18 inches apart each way and trained on wooden stakes to a single stem. The stakes were found more satisfactory than strings for training the tomatoes, since they are more rigid. By training these dwarf tomatoes to a single stem they were easily induced to grow to the height of the forcing house, an average distance of 7 feet or over. It was found desirable to prune away some of the dense foliage to let in light, and to promptly cut off the new branches that often started out from the end of the fruit clusters.

The main value of the dwarf when trained in this manner as compared with the tall-growing or standard varieties is thought to come from the fact that the dwarfs are shorter jointed, and they produce their fruit clusters much closer together on the stem. The average distance apart of the fruit clusters on the average standard is nearly double the distance of that on the dwarfs. This fact taken into consideration, together with their slow growth, not reaching the glass so quickly, is a point in their favor.

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[a] Compiled from Illinois Sta. Bul. 81; Maine Sta. Rpt. 1894, p. 55; New Hampshire Sta. Bul. 84; Amer. Gard., 23 (1902), p. 449.

The fruit began to ripen March 23, and continued in bearing until July 15 following. The three varieties produced on the average 24.7 fruits per plant, weighing 5.1 pounds. The weight of the individual fruits averaged 3.3 ounces each. When these figures are compared with those reported by the Maine Station for six standard sorts of tomatoes, a striking difference is noticeable. The average number of fruits obtained from the latter plants during several seasons, and including both the first and second crops, was 11.8. These weighed but 2.01 pounds, or an average of 2.9 ounces for each fruit. It is but fair to state, however, that the tall-growing sorts had but 1½ to 2 square feet of bench space per plant, while the dwarfs had 2½ square feet per plant. Figuring the yields on the basis of square feet of bench space, however, the results are still in favor of the dwarf varieties.

Summarizing his results, Professor Rane says:

> From data at hand the dwarfs come to maturity fully as early as the tall-growing or standard tomatoes, and on account of their dwarf habit continue in bearing for a much longer period with equal productiveness before reaching the glass. Where tall-growing varieties of tomatoes like the Lorillard can be made a success, dwarf tomatoes under similar conditions and trained to one stem, we believe, will be found much more productive, area for area, and hence more profitable, when time is taken into consideration.

The behavior of the dwarf plants indicated certain advantages over the taller-growing sorts. "They ripened fruit early, the plants were more stocky, the fruit clusters were much nearer together, and the plants did not reach the glass nearly so quickly as the tall-growing sorts."

In similar experiments at the Iowa Station, with standard varieties (Lorillard, Holmes Supreme, Mayflower, Frogmore Selected, and Sutton Best of All) Prof. H. C. Price got, on the whole, the best results with Frogmore Selected planted 15 inches apart and trained to a single stem on a trellis of wire. The average cash return with this variety was $2.53 per plant. The return from Sutton Best of All was $2.06. Lorillard and Holmes Supreme were the earliest varieties.

In reporting forcing experiments with standard varieties Mr. A. C. Beal, of the Illinois Station, calls attention to the fact that the greatest demand for forced tomatoes begins after frost has destroyed the outdoor crop and lasts until the Florida crop comes into the market, usually in February. In order to secure fruit by Thanksgiving Day the seed must be sown by July 20 and the plants benched not later than October 1. Many tomato growers do not secure their first ripe fruits in the forcing house under ninety to one hundred days after benching, but the experiments at the Illinois Station show that not

more than half this time is necessary. "By checking the plants it is possible to secure fruit in fifty days from benching." The experiments at the Illinois Station were with midwinter and spring crops. The varieties tested included Yellow Prince, Combination, Lorillard, Best of All, Eclipse, Stone, and Rosalind. Yellow Prince was decidedly inferior to Combination grown under similar conditions, and since there is no marked demand for the yellow sorts it is considered doubtful whether they are worth growing, except in a limited way for the sake of variety. For the midwinter crop Combination, Lorillard, Best of All, and Eclipse were grown. Seed was sown August 20, and the plants were benched November 7. The first ripe fruit was picked December 24 from each of the varieties Combination, Lorillard, and Best of All. This was forty-seven days after benching. Eclipse did not ripen fruit until December 28, or fifty-one days after benching. The average total yields per plant for the different varieties were as follows: Combination, 4 pounds 6 ounces; Lorillard, 4 pounds 10 ounces; Best of All, 5 pounds; Eclipse, 5 pounds 4 ounces. Best of All was the earliest and best of the four varieties as regards yield during the short, dull days of December, January, and February. Eclipse gave the largest total yield and produced the smoothest and firmest fruits. It was observed that fruits failed to set during long periods of cloudy weather, because of the failure of the pollen to mature readily. For this reason, and in view of the value of the product, it is believed that it will pay the grower to pollinate by hand regularly between December 1 and March 1. Larger and more uniform fruits are thus secured.

For the spring crop Stone and Rosalind were grown in addition to the four varieties grown in the winter experiments. Seed was sown December 26, 1901, and the plants benched April 10. The first ripe fruits were obtained fifty-two days later. With this crop Combination and Lorillard both yielded 3 pounds of fruit per plant, Best of All 3 pounds 6 ounces, and Eclipse 3 pounds 7 ounces. The average yield per square foot for the two crops was about 2.37 pounds. When plants were trained to three stems a yield of 0.8 pound per square foot was obtained, as compared with 1.25 pounds for plants set the same day and trained to a single stem. "The average yield for the season 1901–2, including both the winter and spring crop, was from 2 to nearly 2½ pounds per square foot of bench, or from 7 to almost 9 pounds per stem."

In the above experiments as soon as the plants were large enough they were potted in 2½-inch pots containing fibrous potting soil and afterwards shifted to 3½-inch pots, where they remained about six weeks, when they were benched. At this time they were all showing

open blossoms and were very much pot-bound. (Fig. 3.) This checking of the plants is considered the secret of the early maturity of the fruits, since "unchecked plants come into bearing later, as it takes time to fill the soil with roots and thereby check the excessive growth." The bench soil used was composed of one-half rich garden loam and one-half well-rotted compost. The soil was 6 inches deep in the bench. Wood ashes were applied after the plants were in full bearing. Plants were set 2 feet apart in rows 18 to 20 inches apart. The temperature of the house varied from 70° F. at night to 75° to 80° on cloudy days and as high as 90° on sunny days, but care was taken to keep the temperature as uniform as possible. Leaders were pinched when the plants on the side benches had reached a height of 5 feet and those in the center benches 8 feet. Shoots pushing out from fruit clusters, as is common in rapidly growing plants, were promptly removed.

FIG. 3.—A pot-bound tomato plant ready for transplanting.

The features to which especial attention is called in the above experiments are that dwarf varieties of tomatoes may under certain conditions be more satisfactory to grow in the greenhouse from the standpoint of earliness and productiveness than the standard sorts usually grown; and that the period of ninety to one hundred days after benching usually required for the production of ripe fruit with standard sorts can be reduced to forty-five or fifty days by severely checking the growth of the plants before putting them in the bench. This check is accomplished by permitting the roots to become pot bound before shifting to the bench.

LAYING DOWN PEACH TREES FOR PROTECTION OF BUDS.[a]

The area of successful culture of the peach can be greatly extended if a practical means of protection against severe winter cold and late spring frosts can be found. The Colorado Station has recently called attention to the successful employment in that State of the method of

[a] Compiled from Colorado Sta. Bul. 80; Massachusetts Hatch Sta. Buls. 10, 17.

laying down and covering peach trees in winter. The method as practiced in Colorado apparently does not differ essentially from that tested by Prof. S. T. Maynard at the Massachusetts Experiment Station as

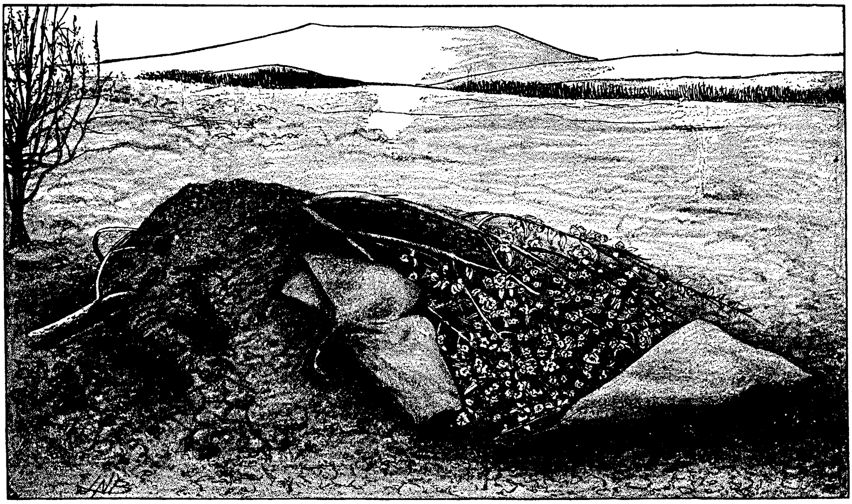

FIG. 4.—A 3 year-old peach tree which has been laid down and covered. The tree is in full bloom.

early as 1886 and during succeeding years except that in the Colorado method irrigation water is used to soften the soil so that the trees may

FIG. 5.—A row of peach trees laid down.

be laid over without any special training or pruning of the roots. The Colorado method, as described by Professor Paddock, is given on the next page.

Yearling trees are set in the spring and they should be laid down the first winter, repeating the process each season during the life of the tree. In this instance no attention is given to training or placing the roots. As soon as the trees have shed their leaves and the wood is well ripened they are ready for winter quarters. * * * The first step in the operation consists in removing the earth from a circle about 4 feet in diameter around the tree. When sufficient trees have been treated in this manner to make the work progress advantageously, water is turned into the hollows. After the ground has become saturated the trees are worked back and forth and the water follows the roots, loosening the soil around them so that they are pushed over in the direction that offers the least resistance. When treated in this manner the trees go over easily and with comparatively little injury to the root system—that is, providing the trees have been laid down each year. It is difficult to handle old trees in this manner that have never been laid down, and usually it will not pay to try.

FIG. 6.—Appearance of the same trees after they have been raised in the spring.

After the trees are on the ground further work should be delayed until the ground has dried sufficiently to admit of ease in walking, and in the handling of the dirt. The limbs may now be brought together with a cord, and so lessen the work of covering.

After experimenting with many kinds of coverings, burlap held in place with earth has proved the most satisfactory. The burlap is spread out over the prostrate tree top, as shown in figs. 4 and 5, taking special pains to protect the blossom buds from coming in direct contact with the earth covering. A light layer of earth is now thrown over the tree and the protection is complete.

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The critical time in growing peaches by this method is in the spring when growing weather begins. Close watch must be kept to see that the blossoms do not open prematurely, or that the branch buds are not forced into tender, white growth. When the blossom buds begin to open, the covering should be loosened so as to admit light and air, but it should not all be removed. More of the covering should be removed as the weather gets warmer, but the blossoms must be exposed to the sun gradually.

Air and light are, of course, necessary for proper fertilization of the flowers, but after this process is complete and the fruit is set, all danger from the weather is considered as being over. The trees are usually raised about the middle of May at Canyon City.

Raising the trees is, of course, a simple task. The ground is again watered and when wet enough the trees are raised. To be sure, trees that have been treated in this manner will not usually stand upright unsupported. Consequently, they are propped up at an angle—usually two props being required to keep the wind from swaying them. (Fig. 6.)

Professor Maynard found that when the trees were covered too closely with soil the buds were killed by heating, but when covered with mats and other light materials a large percentage of the buds were preserved. In some comparative tests made by him about 50 per cent of the buds of unprotected trees were destroyed while only 10 per cent of those of protected trees were killed. Many of the trees used in Professor Maynard's experiments were more than ten years old.

DANDELIONS IN LAWNS.[a]

The common dandelion is a weed which gives much trouble in lawns, since it spreads rapidly, is not injured to any extent by mowing, and unless carefully dug out is very apt to ruin the turf. It is a common practice to give perfect freedom to the women and children, who every spring invade the roadsides and parks or private grounds in search of dandelion "greens." Tests carried on by W. M. Munson at the Maine Experiment Station showed that, contrary to the usual belief, however, this is very bad for the lawns, for in addition to the injury caused by the knives and trowels used in digging the roots, it is very probable that every top or crown cut off will in a short time send up in its place from one to six new crowns.

A hardly less common lawn pest than the common dandelion, especially in New England, is the fall dandelion (*Leontodon autumnale*). This plant, which is often incorrectly called "arnica," makes its growth in late summer and early fall, as its name implies. It takes possession of fields and lawns, its flat, spreading, radical leaves choking out the grass and other plants near it. This, as well as the common dandelion, grows rapidly from root cuttings, and any ordinary digging of the plants has the effect of multiplying them, although to a less extent in case of the fall dandelion than with the spring dandelion.

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[a] Compiled from Maine Sta. Bul. 95.

With a view to ascertaining precisely the behavior of mutilated plants and of young seedlings of both species, the Maine Experiment Station carried on a series of experiments in which seeds were sown and root cuttings were made in the fall, the plants being grown in a greenhouse, where they were under constant observation. It was found that new plants grew rapidly from small root cuttings, and that when the numerous side roots, which are usually found on the dandelion, were severed, each would produce a new plant (see figs. 7 and 8). A dandelion plant cut off about 2 inches below the surface, as is commonly done in digging greens, usually sends up two or more new crowns, as is shown in fig. 9. The fall dandelion, it was found, also grew rapidly from root cuttings; but as this plant is not used as a potherb, it is seldom increased by promiscuous digging. It seeds very freely, however, and spreads rapidly in this way.

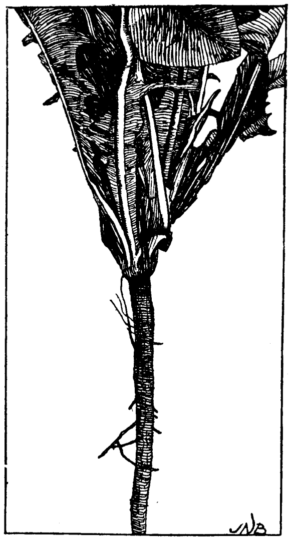

FIG. 7.—Seedling of common dandelion.

Since digging the roots in the ordinary manner will not exterminate the spring dandelion or the fall dandelion, and since both species spread rapidly by seed, it is evident that great care must be used to exclude this pest from the lawn. Professor Munson advises as a preventive measure thick seeding when the lawn is made, for if the young grass plants do not cover all the space, weeds will be sure to grow. If for any reason the lawn has become badly infested with dandelions, renewal by seeding or by sodding is advised. If only a few dandelions are present they may be removed by careful and deep digging, a little grass seed being sprinkled over the space left by the removal of the weed. "Like witch grass, or any other weed, both of the dandelions are readily controlled by frequent cultivation; so that they seldom become serious pests except in grass plats."

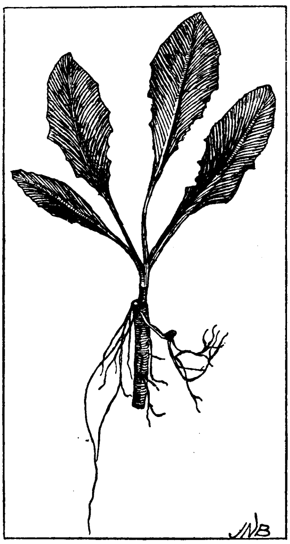

FIG. 8.—Plant from root cutting of common dandelion.

The common dandelion has long been used as a potherb, and though digging it from lawns can not be recommended, there are many places where it can be gathered without harm. It is less commonly eaten as a salad plant in the United States than in Europe, where it is often gathered for this

purpose, especially in early spring when growth has just begun and the leaves are still very small and tender. Dandelion greens are very similar to spinach and other common potherbs in composition. They contain on an average, uncooked, 81 per cent water, 2 per cent protein, 1 per cent ether extract, 11 per cent carbohydrates, and 5 per cent ash, the fuel value being 285 calories per pound. Dandelions have a more decided flavor than spinach, which is caused by a bitter principle contained in the milky juice. Canned dandelion greens may be had in the market and have substantially the same percentage composition as the freshly cooked material. All potherbs are bulky foods and do not furnish a large proportion of nutritive material pound for pound; however, they add a pleasing variety to the diet and are undoubtedly wholesome.

As a cultivated plant the dandelion is assuming an important place in home gardens and in the large market gardens, particularly in New England, where it is grown extensively, yielding large returns per acre. According to the Maine Station it, like celery, is at its best when grown rapidly on rich sandy loam. The station gives in effect the following directions for its cultivaion: Sow the seed in the early spring in drills 12 to 15 inches apart and cover one-fourth to one-half inch deep. As the young plants are small and dark colored and therefore inconspicuous, it is well to mix a few radish or lettuce seeds with the dandelions to mark the rows. They should be given the same culture as carrots during the summer except that they require thinning to 8 to 10 inches apart. The following spring the leaves will be fit for use and are best when partially blanched by placing a covering of boards or boughs over the rows. The blanched dandelions are superior to those growing wild, being more tender and less bitter. The plants are prepared and marketed in the same way as spinach and may be profitably grown at 50 cents per bushel, though the price received is frequently much higher.

Fig. 9.—Dandelion which has been cut for "greens."

In forcing beds the seed may be sown in rows 6 inches apart, or plants may be transplanted from the field. The seedlings are usually more satisfactory. Professor Munson believes that, except in a limited way, forcing dandelions can not be recommended, since other plants mature so much more quickly.

There are only a few varieties of dandelions listed by seedsmen, the most important being French Garden and Improved Thick Leaved.

APPLE POMACE FOR MILCH COWS.[a]

Apple pomace, or cider pomace, has generally been considered an almost worthless waste product, and has been allowed to accumulate in such quantities around cider mills as to become a nuisance. It has been looked upon as too watery to pay for hauling, although in point of fact it contains less water than many root crops. While fed to some extent by an occasional farmer, the general opinion has been that it is of little or no value for this purpose, and the unfortunate experience of some in feeding it has given it the reputation of being an unsafe or unhealthy feed, and of causing shrinkage in milk when fed to cows. This applies to the pomace containing straw as well as that from the more modern mills in which no straw is used.

The fresh pomace ferments quickly when left exposed to the air, and probably for this reason the trials which have been made in feeding it have not resulted very favorably. A farmer in Massachusetts is reported to have preserved the pomace in the forties by placing it in a pit under his barn, thus anticipating the silo. It was kept in this way for months, and fed to cows during the winter. It has now been fully demonstrated that the pomace can be preserved in the modern silo without difficulty, and apple-pomace silage is growing to be appreciated as a cheap and altogether healthful feeding stuff. Its composition as compared with corn silage is shown by the following averages of several analyses:

Average composition of apple-pomace silage and corn silage.

Constituents.	Apple-pomace silage.	Corn silage.
	Per cent.	*Per cent.*
Water	80.2	74.4
Ash	.9	1.5
Protein	1.6	2.2
Fiber	4.5	5.8
Nitrogen-free extract	11.8	15.0
Fat	1.0	1.1
Total	100.0	100.0

Digestion experiments with sheep[b] have shown it to compare very favorably in digestibility with corn silage, over 70 per cent of the total dry matter, 40 per cent of the fat, 60 per cent of the fiber, and nearly 85 per cent of the nitrogen-free extract (starch, sugar, etc.) being digested. No figures were obtained for the protein, the percentage of which is small.

[a] Compiled from Illinois Sta. Bul. 16; Massachusetts Sta. Bul. 21; Vermont Sta. Rpts. 1888, p. 22; 1889, p. 51; 1901, p. 356; 1902, p. 310; Bul. 96.

[b] Made at the Massachusetts Station; not yet published.

The Illinois and Massachusetts stations have shown that apple pomace may be successfully ensiled and thus made available as a feeding stuff for different kinds of farm animals. In experiments at the Illinois Station, however, the pomace silage was not relished by pigs.

Several years ago the Vermont Station reported a trial of ensiling and feeding apple pomace to cows, which indicated that the material possessed considerable value. Fed in rations of 10 pounds per head per day it was eaten greedily, and there was no decrease in the milk flow or other unfavorable result. The next year's trial indicated it to be nearly or quite equivalent in feeding value to corn silage, when used as a supplement to or in part as a substitute for that material.

Recently the Vermont Station has taken the matter up anew and has fed pomace silage up to 35 pounds a day to milch cows with good results. This large amount was eaten up clean and apparently much relished by the cows. For four years the station has fed this silage, in connection with a grain ration, to its herd of 20 or more cows, in amounts varying all the way from 10 to 35 pounds of pomace silage a head daily, with entire satisfaction; and the Massachusetts Station has fed from 25 to 35 pounds a day without any ill effects. The pomace silage has been fed continuously and heavily for five months without injury of any kind to the health of the cows or the milk flow, the latter being maintained remarkably well. Neither the quality of the milk nor the butter was injured in any case. These results seem to demonstrate the feeding value of this material, and to show that no farmer who has a silo and who lives convenient to a cider mill where the material can be had for the hauling should fail to make use of it.

Viewed from the standpoint of feeding value and financial outcome, assuming that apple pomace cost $1 a ton at the farm, the Vermont Station found apple-pomace silage equally as good as corn silage. The material has been fed to a considerable extent in Vermont as a result of the station's work, and its use is spreading to other States. Some dairymen are feeding as high as 45 and 50 pounds a day without ill effects, while others are feeding it in smaller amounts in connection with corn silage.

In view of reported cases of shrinkage when an abrupt change is made from corn silage to pomace silage, it is advised to avoid a sudden change or putting cows on full feed at once, but rather to accustom them to it gradually.

In ensiling apple pomace no special care is necessary. It is the practice at the Vermont Station to simply dump or shovel it into the silo, either on top of corn silage or alone, according to circumstances. It is leveled off and allowed to lie uncovered and unweighted until wanted. It has kept well until far into the spring. A layer on top about 3 inches deep usually spoils, and this moldy silage serves as a blanket to keep the remainder in good condition.

RATIONS FOR LAYING HENS.[a]

An abundance of eggs for home use and for market purposes is desirable at all seasons. Under natural conditions eggs are more freely produced in the warm months than in the winter, and an important problem in poultry feeding is the production of large numbers of eggs during the colder months when prices are high. The effect of early molting on winter egg production is described on page 27, and the value of different rations for winter egg production is described here.

As regards the general food requirements for poultry, W. P. Wheeler, of the New York State Experiment Station, in a recent summary based on station work, points out that the construction of the digestive apparatus of poultry and other birds indicates extreme efficiency and a capacity for rapid work. Like any complicated and delicately adjusted apparatus, he suggests "that it should not be overloaded nor violently disturbed when running at high pressure. It may be said to run at high pressure while the extremely rapid growth of young birds occurs, and during the extended laying season, for the resulting products call for an uninterrupted supply of food and the transformation of all material that is available." It should be borne in mind that "growth and egg production can only be sustained by the food in excess of that required to support life. * * * Hens in full laying seem to require rations which have a larger relative content of protein and ash, and show an increase in fuel value of 15 to 40 per cent, according to size, over those required for maintenance."

According to Professor Wheeler's estimates, when the egg yield is assumed to be 100 per year, the production of a pound of eggs requires 4.56 pounds of digestible organic nutrients in the food, and each pound of increase in the egg yield above this limit requires 5.1 pounds of digestible organic nutrients.

On the basis of a large number of tests carried on at the New York State Station, Professor Wheeler has calculated feeding standards for laying hens as follows, the results being expressed for convenience in calculation on the basis of 100 pounds live weight:

Feeding standards for hens in full laying.

[Digestible nutrients required per day per 100 pounds live weight.]

	Total dry matter.	Protein.	Fat.	Carbohydrates.	Ash.	Fuel value.	Nutritive ratio.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*	
Hens of 5 to 8 pounds weight....	3.30	0.65	0.20	2.25	0.20	6,240	1:4.2
Hens of 3 to 5 pounds weight....	5.50	1.00	.35	3.75	.30	10,300	1:4.6

[a] Compiled from Massachusetts Sta. Rpts. 1896, p. 46, 1900, p. 123, 1902, p. 153; New York State Sta. Buls. 149, 171; Ontario Agr. Col. and Expt. Farm Bul. 127; Utah Sta. Bul. 67; West Virginia Sta. Bul. 83; The Feeding of Animals, W. H. Jordan, 1901, p. 379.

As is the case with feeding standards for other farm animals these values are not regarded as absolute and inflexible, but rather as a starting point which may be followed in the calculation of rations. Judgment in such matters must always be exercised. As a sample of a ration which would correspond to the requirements of the standard mentioned above, Professor Wheeler suggests the following for hens weighing 5 to 8 pounds: Cracked corn 1 pound, wheat 0.75 pound, corn meal 0.75 pound, and 0.5 pound each of wheat middlings, buckwheat middlings, and animal meal, with 0.66 pound of fresh bone and 0.75 pound of young green alfalfa.

The natural food of poultry consists of grains, insects, green forage, and grit, and accordingly in domestication it is reasonable that they should be fed cereal grains and other milling products, such animal feeds as meat meals and skim milk, and should also receive an abundance of green feed or such substitutes for it as roots or steamed clover. Oyster shells, grit, and an abundance of clean drinking water are also prime requisites.

In the United States corn is a favorite feed for chickens, though, as Professor Wheeler states, common grains "seem practically interchangeable and many grain by-products can be freely substituted for different whole grains or for each other and all combined as desired."

The Massachusetts Station has compared corn with wheat and corn with buckwheat, beef scraps or other animal feed constituting a part of the ration in every case. As regards corn and wheat, the results for several years have not been entirely consistent, though on the whole the egg yield on both grains has been satisfactory. In a comparison of corn and buckwheat, "the egg yield has been rather small with the advantage decidedly in favor of the corn."

In a test at the Utah Station the egg yield on a wheat ration was better than on corn, though both grains were fairly satisfactory. Substituting sunflower seed for most of the corn did not materially affect the egg yield, though the cost of feed per dozen eggs was somewhat greater on the sunflower-seed ration.

In Ontario, an important poultry region, where the winters in general are more severe than in the United States, wheat, according to Prof. W. R. Graham of the Ontario Agricultural College, is the most popular feed. Corn, he states, is not used there to so great an extent as in the New England States, though he believes that its use is justified and might be profitably extended. Owing to its high fuel value, and fat-producing qualities, it is an important addition to winter rations. According to Professor Graham—

Oats should be a first-class food for poultry; but, owing to the large percentage of hull, they are not relished by chickens, and for this reason they are somewhat indigestible. When ground, they are used pretty freely in mash food; also, the rolled

and granulated oatmeals are used for feeding young chicks. The ground oat, without the hull, is used extensively for fattening fowls.

Barley, either whole or ground, is very good. It has rather too much hull; but otherwise it is a satisfactory food. It is considered by many to be next to wheat in point of value.

Buckwheat is very popular as an egg-producer in districts where it is grown extensively. Some difficulty is at times experienced when first feeding it to fowls in getting them to eat it, but this is usually overcome in a day or so, if other feeds are withheld. Boiling the buckwheat will sometimes start the birds to eat it. After the birds once get accustomed to its appearance, it is much relished by them. Ground buckwheat is an excellent food to use in a fattening ration. It is somewhat like corn in its fattening properties, and therefore it is better for winter than summer use.

Shorts and wheat bran are both used extensively in making mashes, or soft foods. They are excellent foods to use in maintaining the health of the flock.

The relative merits of whole grain and of ground grain made into a mash have been studied from time to time. The practice of successful poultry raisers and the results of numerous tests show that to secure the best results the day's rations should be made up of both sorts of feed. In experiments at the West Virginia Station better results were obtained with both old and young fowls "when about one-third of the grain ration was fed ground and moistened than when all of the grain was fed whole and scattered in the litter." Scattering a portion of the unground grain, however, has the advantage of compelling the hens to take exercise which they need. Opinions differ somewhat as to the proper time for feeding whole grains and the mash. According to tests at the Massachusetts Station, the best results followed feeding the mash in the morning and the grain at night. According to Professor Graham, it is more satisfactory to feed the mash at night.

The objection to the former plan [he states] is that the hen is likely to become gorged with food early in the morning, and thus take to the roost for the rest of the day, which is usually followed by hens becoming too fat, and the egg record becoming small; but notwithstanding, many successful poultrymen use this method to advantage. The objection to feeding the mash at night is that it becomes quickly digested, and the bird has not sufficient food to last it during the long winter night; but this objection can be overcome by giving a little whole grain after the mash at night.

In experiments at the West Virginia Station the egg production was practically the same whether the mash was fed in the morning or at night.

Some poultrymen feed their flocks twice a day and others three times. According to Professor Graham three meals are more satisfactory. At the Ontario Agricultural College the fowls are given early in the morning half a handful each of whole grain buried in the litter which covers the poultry-house floor, which must be searched for. At noon they receive about two handfuls of grain per dozen hens, which is scattered as before, and are also given all the roots (mangel-wurzels,

sugar beets, or turnips) they can eat, either pulped or whole. Sometimes cabbage takes the place of roots. About 4 o'clock in the afternoon during cold weather they are given a mash composed of equal parts of bran, shorts, oat chop, and corn meal to which about 10 per cent of animal meal has been added, or cut green bone or cooked meat. These feeds are thoroughly mixed together and then added to steeped clover, sufficient water being used for soaking the clover to moisten the grains. As regards amount, it is planned to have the clover constitute about one-third the bulk of the ration. After the mash the hens are given a little whole grain scattered in the litter.

In a milder climate than that of Ontario less frequent feeding would probably give equally good results.

Different kinds of animal feed, such as meat meal and cut green bone, have been compared at a number of stations, notably at the Massachusetts Station and more recently at the West Virginia Station, the general conclusion which may be fairly drawn from all the tests being that the more common materials of this kind are about equally satisfactory provided they are of good quality.

It was observed in a test at the Utah Station that pullets fed dried blood as a part of the ration began to lay earlier than those given none. In some cases this feed seemed to increase markedly the egg production, though in others the yearly egg yield was not materially affected by the addition of dried blood to the ration.

Animal feed is usually regarded as essential[a] for poultry, especially for ducks, but a series of tests carried on at the New York State Station indicates that the better results obtained with rations containing animal matter are due largely to the greater proportion of mineral matter which such rations contain and that equally good results may be obtained with chickens by feeding a ration made up of vegetable feeding stuffs, provided mineral matter is added to the ration to take the place of that which is lacking in the vegetable feeding stuffs as compared with animal products. The experiments of the New York State Station bring out very clearly the importance of providing laying hens with rations containing an abundance of mineral matter, a point which is sometimes neglected. It is especially important that the rations should be well supplied with lime and phosphates, which are essential to the formation of egg shells, bone, and other tissue. "Most grain foods which naturally constitute the bulk of ordinary rations contain little mineral matter and the amount of lime is notably low." The lime and phosphates may be supplied in oyster shells and bone ash. It is considered best, however, in practice to use some animal food.

[a] U. S. Dept. Agr., Farmers' Bul. 97 (Experiment Station Work, X), p. 16.

The green feeds which are justly considered so important add to the palatability of the ration, furnish a considerable amount of nutritive material, and undoubtedly help to maintain hens in good condition. The New York State Station recommends for this purpose the more nitrogenous forage plants such as clover, alfalfa, and immature grasses. "These feeds also contain more of the needed lime than do grains." It must be remembered that fowls are not fitted to depend too largely upon bulky feed and that the proportion of grain in the ration must always be fairly large. According to Professor Wheeler, another and very important reason, which is sometimes overlooked for using such foods as young clover, fresh or dried, is the effect on the color of the egg yolk.

Eggs from hens which are fed only certain grain and animal substances generally have yolks of a pale yellow color. This is often objected to by those who have a preference for eggs with darker, orange-colored yolks. The liberal feeding of fresh or dried young clover, alfalfa, or grass will generally insure the deeper coloration. The cause of this frequent lack of what may be considered the normal yellow color of the egg yolk is not well known, but the occurrence of the pale color can be generally prevented by attention to the food.

The above facts are illustrated by the results of a test at the New York State Station in which four lots of hens were fed alike except that no hay nor green feed was given to one, while the others had different amounts of clover hay alternating with green alfalfa. The eggs showed marked differences in color. Those laid by the hens having no green feed had yolks of a light shade, the color increasing in intensity with the proportion of hay or green feed in the ration. The greenish tint of the white also varied, but not so regularly.

PRODUCING EARLY MOLTING IN HENS.[a]

The West Virginia Station calls attention to the fact that "when a specialty is made of producing winter eggs it is of much importance to have the hens shed their feathers early in the fall, so that the new plumage may be grown before cold weather begins. In case molting is much delayed the production of the new coat of feathers in cold weather is such a drain on the vitality of the fowls that few if any eggs are produced until spring, while if the molt takes place early in the season the fowls begin winter in good condition, and with proper housing and feeding may be made to lay during the entire winter." The station reports tests on 2-year-old Rhode Island Reds and White Leghorns of the Van Dresser method of promoting early molting, which "consists in withholding food either wholly or in part for a few days, which stops egg production and reduces the weight of the fowls, and then feeding heavily on a ration suitable for the formation

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[a] Compiled from West Virginia Sta. Bul. 83.

of the feathers and the general building up of the system." Beginning August 5 the chickens received no feed for thirteen days except the very small amount they could pick up in 15 by 100 foot runs. They were then fed liberally on mash, beef scraps, corn, wheat, and oats, i. e., a ration rich in protein or nitrogenous matter, which is believed to be especially valuable for promoting the growth of feathers as well as muscle. The hens stopped laying on the seventh day. Thirty days after the test began the Rhode Island Reds had practically a complete coat of new feathers, had begun to lay, and within a week from that time one-half of the hens were laying regularly, while another lot of Rhode Island Reds, which had been fed continuously, were just beginning to molt, and the egg production had declined materially. The White Leghorns were a trifle slower in molting than the Rhode Island Reds, but otherwise the treatment affected them in a similar way.

The results seem to warrant the general conclusion that "mature hens which are fed very sparingly for about two weeks and then receive a rich nitrogenous ration molt more rapidly and with more uniformity, and enter the cold weather of winter in better condition than similar fowls fed continually during the molting period on an egg-producing ration."

CONTROL OF EVAPORATION FROM INCUBATOR EGGS.[a]

The success of artificial incubation depends to a very large extent upon maintaining the proper moisture conditions in the egg chamber. In the past, operators have been compelled to rely almost entirely upon experience to determine whether the proper conditions are being maintained.

Some reliable means of controlling moisture conditions which may be safely employed by inexperienced as well as experienced operators is especially important in view of the rapid extension of artificial incubation. The West Virginia Experiment Station, taking as a basis for such a method the normal loss of weight of eggs during incubation under brooding hens, made a series of observations which showed that the eggs which hatched under hens lost on an average 16.5 per cent of their weight in nineteen days, while the infertile eggs and those which did not hatch lost from 1 to 2 per cent less. The normal loss of 100 eggs was found to be about 10 ounces in six days, 20 ounces in 12 days, and 31 ounces in eighteen days. By weighing the eggs in the tray at the beginning of incubation and at intervals thereafter the progress of evaporation may be observed, and the ventilation and moisture supply so regulated as to make the loss of weight conform to these normal figures.

[a]Compiled from West Virginia Sta. Bul. 73.

THE KEEPING QUALITY OF BUTTER.[a]

In a recent bulletin of the Iowa Station one way of making butter which will keep longer than ordinary butter is described and tests of the method are reported. It is a very important advantage to have butter keep well, and to improve the keeping quality of butter increases just so much its real value. Butter which spoils quickly is not suitable for export; it can not be kept very well until higher prices can be secured; and in fact, sometimes it can hardly be sold or even be placed in cold storage before a disagreeable flavor is developed. It has been quite clearly established that microscopic organisms are the cause, or at least one of the causes, of rancid butter. The particular forms of organism responsible for this deterioration gain access to the milk, or the cream, or the butter. The problem is to exclude them, or to destroy them when they are present. Butter makers understand pretty well that pasteurization is often of very great value in making butter. But why pasteurize the milk or cream and then wash the butter with dirty germ-laded water? The Iowa Station took some ripened cream, divided it into two equal lots, churned one of the lots and washed the butter with ordinary well water, churned the other lot under the same conditions and washed the butter with the same well water, but not until after the water had been pasteurized and cooled. Three experiments were made in the same way and the results all showed that the butter washed in the pasteurized water kept normal very much longer than the same butter washed in the unpasteurized water. Here is pretty good evidence on an important point. Furthermore, the cream was pasteurized as well as the wash water, and it was found that the keeping quality of the butter was still further improved. The butter made from unpasteurized cream and washed with unpasteurized water kept thirty-four or thirty-five days, while that made from pasteurized cream and washed with pasteurized water kept sixty to seventy-five days. The pasteurization of the wash water is a simple matter, but entails some trouble and some expense. The Iowa Station estimated the cost of pasteurizing both the milk and the wash water at 0.1 cent per pound of butter produced. Filtration is perhaps better, as organic matter and other impurities are removed along with about 95 per cent of the bacteria. A filter composed of the following layers mentioned in order, commencing at the top, worked very well at the Iowa Station and was inexpensive: Coarse gravel, 2 inches; charcoal, 9 inches; fine coke, 12 inches; fine sand, 22 inches; and coarse gravel, 2 inches. Such filters of course require some attention, but care is necessary throughout the process of production of good butter.

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[a] Compiled from Iowa Sta. Bul. 71.

CURING CHEESE IN COLD STORAGE.[a]

Attention was called in an earlier number of this series[b] to the favorable results that had been obtained, experimentally, in curing cheese at temperatures somewhat lower than those generally employed. It was noted that better results had been obtained in curing cheese at 50° and 55° F. than at higher temperatures. Since then several experiments have been made in curing cheese at still lower temperatures. In the annual report of the Wisconsin Station for 1901 several series of experiments made during a period of four years were reported. Cheese was cured at temperatures ranging from 15° to 60°. Good results were obtained at all temperatures from 33° to 50°, indicating that the ordinary temperatures secured in cold-storage rooms are suitable for this purpose. The experiments showed that cheese cured in cold storage lost less in weight than cheese cured at 60°, and was superior in flavor, texture, and keeping quality. These results were later confirmed by a continuation of the investigations. It was also found that the mild flavor characteristic of cold-cured cheese could be intensified if desired by subsequent exposure to a somewhat higher temperature, and that ripening in cold storage could be hastened with advantage by the use of increased quantities of rennet. The effect of low temperature in reducing the loss of moisture during curing has also been shown by experiments at the New York State Station. In one of the experiments reported cheese cured at 32° lost 3 per cent in weight in five weeks, while cheese cured at 55° lost 4.6 per cent. Preliminary reports upon experiments in progress at the Ontario Agricultural College have also been favorable to cold curing. Twenty-six experiments were made from April to November, 1901, the results of which showed that cheese cured at about 40° lost 2.1 per cent in weight during the first month, while cheese cured at about 60° lost 4.4 per cent. The cold-cured cheese scored on an average 92.4, while the cheese cured in the ordinary way scored 85. These and other experiments at the Ontario Agricultural College have indicated that cheese ripens about as much in one month in the ordinary curing room as in four months in cold storage. These experimental results, showing that cold curing reduces the shrinkage and improves the quality of cheese, have lately been confirmed by tests of cold curing under commercial conditions which it is the main purpose of this article to outline.

In cooperation with the Dairy Division of the Bureau of Animal Industry of this Department the Wisconsin and New York State Sta-

[a] Compiled from New York State Sta. Buls. 207, 234; Ontario Agr. Col. and Expt. Farm Rpts. 1901, p. 48, 1902, p. 40, Bul. 121; Wisconsin Sta. Rpts. 1901, p. 136, 1902, p. 150, Buls. 94, 101; U. S. Dept. Agr., Bureau of Animal Industry Bul. 49.

[b] U. S. Dept. Agr., Farmers' Bul. 144 (Experiment Station Work, XIX), p. 27.

tions carried out practical tests of curing cheese at temperatures of 40°, 50°, and 60°. The work was done during 1902 and 1903, and included, in addition to a study of the effect of cold curing on the quality and keeping property of cheese, a study of the effect of coating cheese with paraffin. In the western experiments cheeses of various types were purchased from factories in Wisconsin, Iowa, Illinois, and Michigan, and placed in cold storage at Waterloo, Wis. In the eastern experiments representative cheeses were purchased in New York, Pennsylvania, and Ohio, and cured in New York City. This arrangement in both cases involved delays in transportation and other unfavorable circumstances, but made the tests of a character likely to occur in practice. Examinations of the cheese were made at intervals by a committee of experts, who, in addition to judging the flavor, texture, and color of the cheeses, placed a commercial valuation upon them. The results of the work have very recently been reported.

The two series of experiments agree as regards the loss in weight of cheese during curing. In Wisconsin the cheese cured at 50° and 60° lost fully three times as much in ninety days as the cheese cured at 40°. It is believed that under existing factory conditions cheese loses four times as much in twenty days as was lost in cold storage at 40° during the ninety-day period. Typical Cheddar cheese lost much less in weight than cheese of the softer types. In cold storage rooms in which the air was very moist the loss at 40° was practically independent of the size of the cheese. At higher temperatures, however, the smaller cheeses lost much more in proportion to their weight than the larger cheeses. In New York the cheese cured at 40° lost on an average 3.8 per cent in twenty weeks, while the cheese cured at 50° lost 4.8 per cent, and at 60° 7.8 per cent. Here also large cheeses lost relatively less in weight than those of smaller size.

The results also agree as regards the effect of cold curing upon the quality of the cheese. In the Wisconsin experiments typical Cheddar cheese afforded better results than soft cheese. This type of cheese ripened more rapidly at 60°, and was of excellent quality, but eventually it was surpassed by the cold-cured cheese. In the New York experiments the general averages of the scores made at the end of twenty weeks were as follows: Cheese cured at 40°, 95.7; cheese cured at 50°, 94.2, and cheese cured at 60°, 91.7, the difference in quality being confined in most cases to flavor and texture. In both series of experiments the keeping quality of the cheese was very much improved by cold curing.

The results on the whole were favorable to the use of paraffin in coating cheese. In no case were injurious effects observed. In cheese cured at 60° the Wisconsin Station found a loss in the uncoated cheese 50 per cent greater than that in the coated cheese. At 40° the

coated cheese lost slightly more in weight than the uncoated cheese. In paraffined cheese cured at 40° and 50° in New York the loss was less than 0.5 per cent, and in cheese cured at 60° the loss was 1.4 per cent. In the uncoated cheese the loss at all temperatures was much greater, and was about five times as much at 60°. The quality of the cheese was not considered as affected by paraffining in Wisconsin, while in New York the commercial qualities of the cheese were considered as favorably influenced by paraffining. In addition to protecting cheese from mold paraffining therefore lessens the loss in weight, especially where higher temperatures are employed, and may improve the quality of the cheese.

To determine the increased market value resulting from cold curing the New York State Station combined the improvement in quality with the increase in quantity, estimating that 100 pounds of cheese stored at 60° would, under the conditions of the experiment, give a return of $11.69; 100 pounds of cheese stored at 50°, $12.42, and 100 pounds of cheese stored at 40°, $12.77, making a gain of $1.08 per hundred from storage at 40° as compared with storage at 60°. As compared with ordinary factory conditions the advantage of cold curing would be much greater than this.

The temperature of 55° to 60° corresponds to what has been termed "cool" curing in Canada, and is strongly advocated there, especially on account of its practicability. The good results of "cool" curing have been confirmed in an extensive series of experiments, conducted in four large experimental curing rooms, erected and equipped by the Canadian Government at central points.

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